


Case Studies and Lessons Learned


by

Richard Cronce, Ph.D.

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SYSTEMS**OPTIMIZATION**




Relevant Experience and Proven Results


- Over 600 major environmental projects in NE including 100 DOD and 31 CERCLA sites
- Over 20 tasks involving RI/FS, risk assessment, and public and regulatory interface
- Optimization of >25 remedial programs involving 100s of components
- Diverse climatic, site environmental, and contaminant conditions
- Full range of remedial technologies



Project	Annual Savings	Return on Investment	Life Cycle Savings
US Navy Fridley NIROP	\$160K	2.5 Yrs.	\$1.4M
Former Naval Ordnance Plant	\$210K	1.9 Yrs.	\$2.6M
US Army Aberdeen P.G.	\$460K	2.6 Yrs.	\$4.3M
Olivetti Supplies, Inc.	\$110K	1.5 Yrs	\$1.3M
US Air Force Loring AFB	\$74K	4.0 Yrs.	\$320K
Kodak Corp. Sterling 3	\$147K	1.4 Yrs.	\$1.6M
Lang Superfund Site	\$350K	0.9 Yrs.	\$3.6M
AstraZeneca	\$90K	3.0 Yrs.	\$400K
South Jersey Clothing Site	\$29K	1.0 Yrs	\$500K
Higgins Farm Superfund Site	\$23K	1.3 Yrs	\$460K
Matlack	\$41K	2.1 Yrs	\$820K
Vineland Chemical	\$660K	1.05 Yrs.	\$9.7M




SAIC has proven optimization savings




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Project Overview – Fridley NIROP

- CERCLA site in Fridley, MN
- PUMP and treat of TCE contaminated groundwater
- Six extraction wells, treatment by tray aerators, carbon polishing of air and water, discharge to Mississippi River
- Treatment facility operated by independent contractor on active manufacturing site
- Treatment ongoing since 1992.
- Annual budget \$750K




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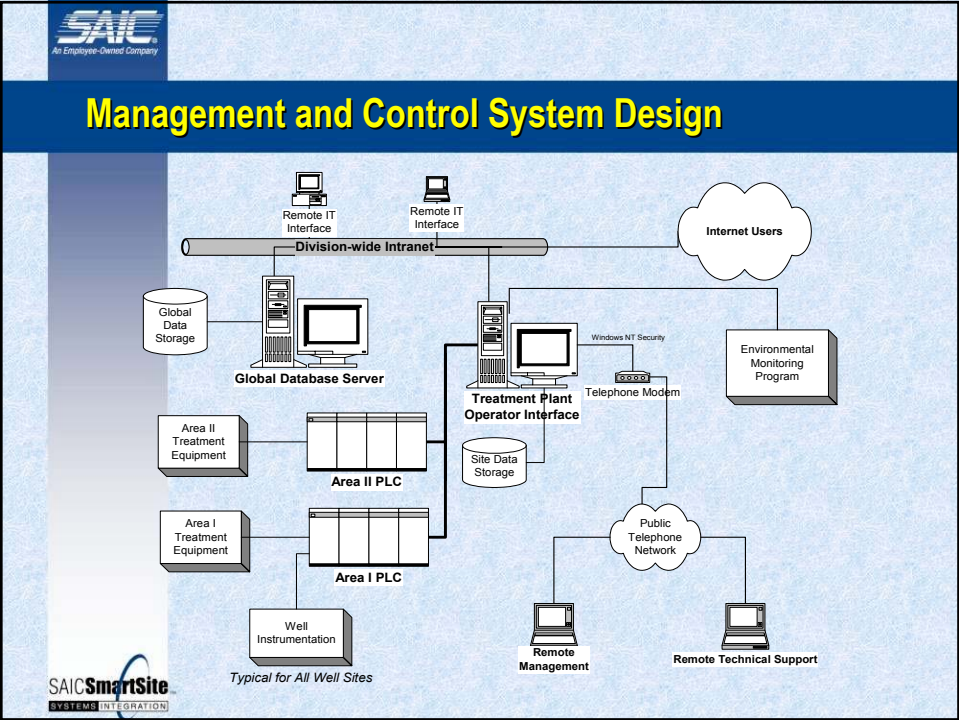
Example Optimization Alternatives – Fridley NIROP

Problem or Program Element	Solution	Annual Cost Savings (x 1,000)
Excessive System Fouling	Install Additional Wells and Reduce Pumping Rates	\$ 75
Inefficient Pumping of Discharge Water	Gravity Discharge Through Automated Bypass Line	\$ 16
High Pumping Electrical Costs	Install Variable-Speed Drives	\$ 8
Maintenance Labor	Perform SCADA Supported Predictive Maintenance	\$ 3
Environmental Monitoring	Streamline Environmental Monitoring	\$ 27
Well Field Monitoring	Upgrade Well Field Sensors and Automate Monitoring	\$ 15
Treatment System Monitoring and Data Acquisition and Reporting	Upgrade of SCADA System	\$ 16
Total Savings		\$ 160



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¹ Represents approximately 20 percent of annual O&M budget and provides a return on investment (ROI) of approximately 2.4 years.



Summary of Results – Fridley NIROP


- 8 alternatives for improvement identified and evaluated
- Life-cycle optimization of system design, operation, and maintenance will reduce O&M costs by 20 % (160K/yr) with a ROI of 2.4 yrs, and \$3.2M over the life of the program.
- Monitoring costs reduced by \$26.6K/yr
- Numerous alternatives already implemented


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Project Overview – O Field Landfill


- Optimization and engineering of leachate collection and monitoring system of a major landfill at Region III CERCLA Superfund Site
- Chemical warfare agents landfill at Aberdeen Proving Ground, MD
- Pump and treat of solvents and metals plume from landfill
- 14 extraction wells, metals/solids removal, packed tower aeration, UV oxidation, GAC polishing, bio-monitoring, discharge to Chesapeake Bay
- Extensive Groundwater/Air Monitoring Program
- Security issues
- Independent LTO/LTM Contractor
- \$1.7M/yr annual budget






Example Optimization Alternatives – O Field Landfill

<u>Problem or Program Element</u>	<u>Solution</u>	<u>Annual Cost Savings (x 1,000)¹</u>
Well Field Management	Install Additional Wells, Optimize Well Field Pumping Rates	\$ 36
Groundwater Extraction System Pump Performance and Extraction System Fouling	Replace Pumps and Water Level Controls	\$ 31
Lime Feed system	Replace Bag Lime with Bulk Sodium Hydroxide Feed	\$ 28
Upflow Sand Filter	Replace Sand Filter	\$ 28
Air Stripping Tower	Discontinue Use But Do Not Remove the AST	\$ 55
Sludge Management	Replace Drums with Bulk Sludge Storage and Handling	\$ 36
Effluent Monitoring Water Conditioning System	Upgrade System Construction, Replace Chiller Unit	\$ 31






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Example Optimization Alternatives – O Field Landfill (cont'd)


Problem or Program Element	Solution	Annual Cost Savings (x 1,000) ¹
Well Field Control and Monitoring	Install and Execute SCADA Supported O&M	\$ 31
GWTF Control and Monitoring	Install and Execute SCADA Supported O&M	\$ 54
Well Field Environmental Monitoring Program	Reduce Number and Frequency of Sampling	\$ 47
GWTF Environmental Monitoring Program	Develop Reliable Off-Gas Monitoring Program Using Field Methods	\$ 17
Data Management and Reporting	Develop SCADA Supported and Standardized/Automated Data Analyses and Report Generation	\$ 69
Other	Reduce GAC Loading, Upgrade Emergency Generator, Execute SCADA-Supported O&M	\$ 11
Total Savings		\$ 458 ²

¹ Based on preliminary results.

² Represents approximately 40 percent of annual O&M budget and provides a return on investment (ROI) of approximately 2.6 years.




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Example Relationships Between Program Optimization Alternatives and Resultant Cost Savings – O Field Landfill

Alternative	Resultant Cost Saving	Annual Cost Savings (x 1,000) ¹
Optimize Well Field Management	Reduce Well Field and Pump O&M	\$ 3.6
• Install Additional Wells • Optimize Well field Pumping Rates	Reduce Weekend Operations	\$ 1.7
	Reduce Sludge Management/Disposal	\$ 1.9
	Provide Treatment Capacity for IDW - Eliminate Off-Site Disposal	\$ 28.4
Total Savings		\$ 35.6
Upgrade Lime Feed System	Reduce Normal O&M Costs	\$ 20.2
• Replace Bag Lime With Liquid Sodium Hydroxide Feed	Reduce Compensatory Overtime Due to Downtime	\$ 10.2
	Reduce Pump Replacement	\$ 1.4
	Reduce Sludge Management/Disposal	\$ 1.2
	Reduce Utility Costs	\$ 2.6
	Increase Chemical Costs	\$ -7.5
Total Savings		\$ 28.1




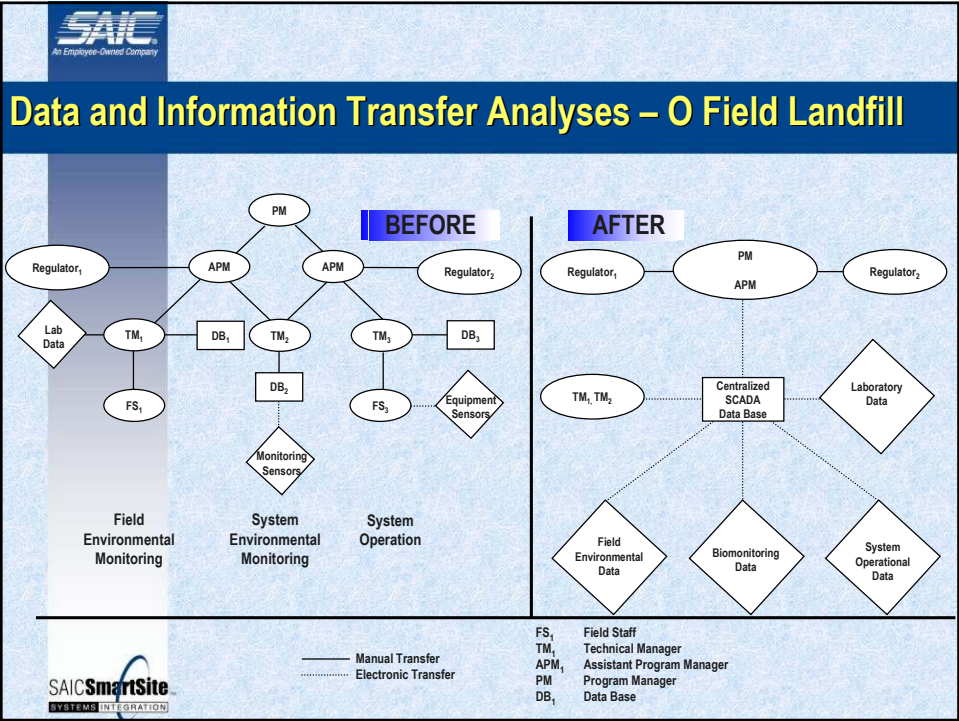
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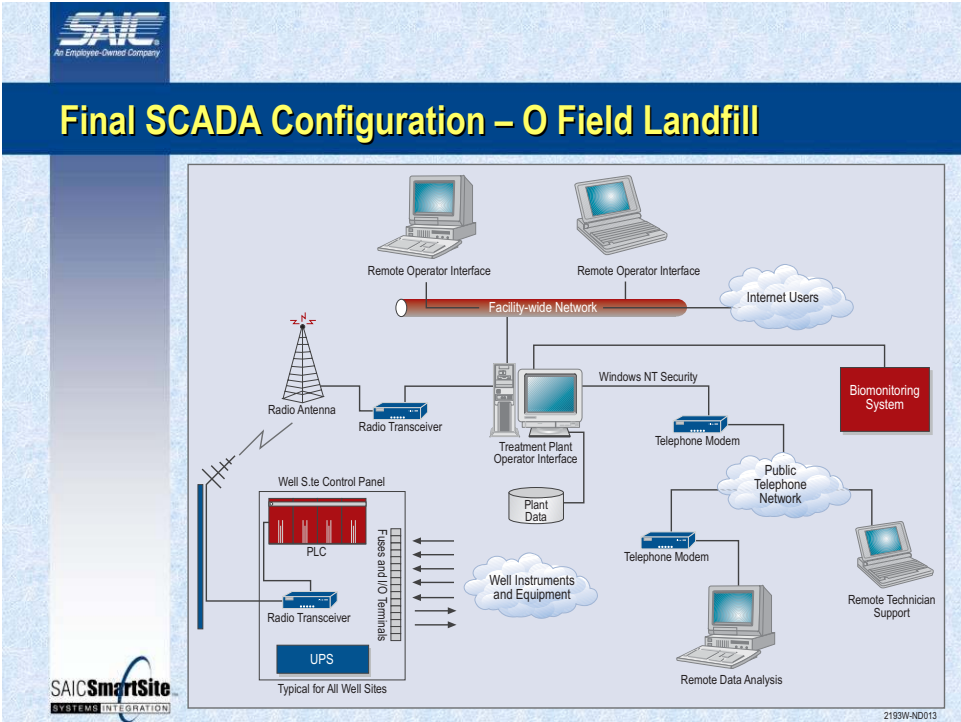

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Example Relationships Between Program Optimization Alternatives and Resultant Cost Savings (cont'd)


Alternative	Resultant Cost Saving	Annual Cost Savings (x 1,000) ¹
Upgrade Effluent Water Monitoring System	Reduce Normal O&M Costs	\$ 3.9
	Reduce Unscheduled Alarm Response	\$ 6.2
	Reduce Compensatory Overtime Due to System Downtown	\$ 3.2
	Reduce Unscheduled Sampling/Analyses	\$ 12.1
	Reduce Event Administrative/Regulatory Reporting	\$ 6.0
	Total Savings	\$ 31.4
Upgrade of SCADA System	Reduce Data Collection Costs	?
	Reduce Data Input/Transfer	?
	Reduce Data QA/QC	?
	Reduce Data Analyses and Reporting Costs	?
	Reduce System and Manifold Maintenance Costs	?
	Reduce Administrative Management and Travel Costs	?
	Total Savings	?


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- Summary of Results – O Field Landfill**
- 18 alternatives for improvement identified and evaluated
 - Life-cycle optimization of system design, operation, and maintenance will reduce O&M costs by 40 % (460K/yr) with a ROI of 2.6 yrs, and \$4.3M over the life of the program.
 - Monitoring costs reduced by 25% (\$17.5K/yr)
 - Recommendations incorporated into the 5 yr CERCLA report
 - SAIC awarded and completed design/installation of advanced SCADA system
 - Numerous alternatives already implemented
- The diagram is labeled 'SAICSmartSite SYSTEMS INTEGRATION'.



Project Overview – Vineland Chemical Superfund Site


- CERCLA site in NJ Pinelands in operations since 2000
- Arsenic contaminated soils and groundwater
- 13 extraction wells (750gpm), chemical oxidation, coagulation/flocculation, solids separation/removal, surface water discharge
- Pumping at 50% of design capacity
- Numerous operational problems identified
- \$3.8M/yr annual budget






Vineland Chemical Cost/Alternatives Summary

Program Element	Alternative Evaluated	Initial Cost	Annual Cost Savings	Life-Cycle Savings ¹	Return on Investment (years)
Well Field Management for Flow Maximization	Redevelop 14 RW's, reconstruct RW-9, and hydrogeologic testing of two RW's	\$173,000	N/A	\$1,765,950	N/A
Fouling of Groundwater Extraction Pumps	Addition of automated sequestering agent system.	\$36,000	(\$43,538)	(\$635,293)	(0.8)
Performance of Groundwater Influent Lines	New transfer main	\$288,360	\$19,360	\$69,000	15
Well Vault Monitoring and Maintenance	Replace covers, seal vaults, and grade area.	\$32,200	\$22,822	\$281,920	1.4
Hydraulic Capacity of the Treatment Plant	Add level control for coagulation tanks	\$7,040	\$550	\$500	12.9
Performance Enhancement Through Flow Equalization	Addition of equalization tank system	\$156,500	\$51,300	\$549,635	3.0
Chemical Usage Rates	Optimization of current protocols, eliminate second organic train, chemical elimination, and addition of polishing unit.	\$296,093	\$337,068	\$4,343,585	0.9
Performance of DAF Units	Modify discharge pipe weir and add internal sludge collection pipes.	\$25,660	\$24,500	\$311,647	1
Performance of Chemical and Polymer Feed Pumps	Replace existing pumps and add two new chemical dilution stations.	\$25,000	\$4,300	\$34,200	5.8
Performance of Flow Meters	Replace well flow meters with magnetic	\$27,300	\$10,920	\$123,012	2.5




¹Assumes a 30-year period of operations for life cycle cost estimating.




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Vineland Chemical Cost/Alternatives Summary (Cont)

Program Element	Alternative Evaluated	Initial Cost	Annual Cost Savings	Life-Cycle Savings ¹	ROI (years)
Compressed Air System	Add third compressor.	\$15,600	\$1,875	\$10,195	8.3
Sludge Dewatering and Management	Replace centrifuges with filter presses	\$280,500	\$96,300	\$1,045,400	2.9
Installation of MOVs in Chemical Storage Facility	Install motor operators on valves	\$64,175	\$315	\$0	>30
SCADA System – Well Field Control and Operations Monitoring	Implement SCADA well field control and monitoring	\$45,660	\$6,370	\$42,022	7.2
SCADA System – Treatment Plant Control and Operations Monitoring	Implement integrated plant control and monitoring	\$104,200	\$28,600	\$289,474	3.6
SCADA System – Operator SCADA Control of Chemical Feed Rates	Integrate chemical feed rate control into PLC	\$50,000	\$25,662	\$303,233	2.0
PLC and VFD Maintenance and Obsolescence	Perform VFD survey and substitution design	\$6,200	\$0	\$0	N/A
Environmental Monitoring – Well Field Monitoring	Optimize sampling frequency and install dedicated sampling pumps	\$124,500	\$63,440	\$748,741	2.0
Environmental Monitoring – Treatment Plant Monitoring	Reduce frequency of two off-site sampling parameters.	\$19,500	\$11,720	\$141,824	1.7
Data Management and Reporting	No opportunities for improvement identified	N/A	N/A	N/A	N/A
TOTAL	\$1,296,873	\$657,778	\$9,696,354	1.05	




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Summary of Results – Vineland Chemical Co.

- 22 alternatives for improvement identified and evaluated
- Life-cycle optimization of system design, operation, and maintenance will reduce O&M costs by 18 % (660K/yr) with a ROI of 2.5 yrs, and \$9.7M over the life of the program.
- Monitoring costs reduced by 40% (\$75K/yr)
- SAIC awarded and currently completing design/installation of advanced SCADA system in both GWTF and Soil Washing Treatment Plant
- Implementation strategy developed for yearly investments in cost savings over 5 year period.
- Numerous alternatives already implemented



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Optimization of Groundwater Monitoring Programs

- Olivetti Supplies - Negotiated reduced sampling requirements
- Aberdeen Proving Grounds – Utilized automated data collection
- Carswell Air Force Base – Application of powerful modeling and mathematical analysis

Optimization has achieved savings through revised regulatory decision, enhanced sampling, and use of automated data collection

Site	Developed Alternative	Annual Cost	Annual Cost Savings	ROI (Yrs)
Former Naval Ordnance Plant, PA	✓ Developed streamlined “key well” sampling program to reduce number of frequency in sampling	\$250K	\$105K	.025
MMR, Cape Cod, MA, Silewide Monitoring Program	✓ Reduce sampling locations and frequency of sampling	\$650K	\$244K	0.6
Loring Air Force Base, ME—landfill monitoring	✓ Reduce sampling frequency and parameter	\$7.2K	\$1.8K	4.2
NIROP, Fridley, MN—Groundwater P&T system	✓ Reduce sampling locations and frequency ✓ Change method of analysis	\$67K	\$26.6K	0.8
Loring Air Force Base, ME—Groundwater discharge to surface water	✓ Replace standard well sampling with diffusion gas sampling and on-site analysis	\$100K	\$50K	0.5
Aberdeen Proving Grounds—O-Field Landfill Monitoring	✓ Reduce sampling locations and frequency, amend analytical protocols ✓ Install automated data collection	\$350K	\$17.5K	1.7
Olivetti Supplies, Inc., Harrisburg, PA—Groundwater P&T System	✓ Negotiated regulatory requirements to replace laboratory with on-site analysis ✓ Installed remote/automated monitoring equipment	\$144K	\$54K	2.7
		\$104K	\$28K	1.5
Carswell AFB, Basewide LTM	✓ Used Kriging/autocorrelation to reduce sampling number	\$235K	\$86K	0.15
SSCOM Natick	✓ Used numerical modeling/time series analysis to reduce number and frequency of sampling	\$400K	\$132K	0.8





SmartSite® Streamlines the CERCLA Five Year Review Process

- **Standardized Data Collection Modules** include essentially all of the information required for completion of Level I through Level III of the five-year review matrix.
- **Results** provide the performance evaluation/effectiveness documentation for the CERCLA five-year review process.
- **Documented Performance Metrics** are directly applicable and transferable to the 5-year review process.
- **Properly Optimized LTO/LTM Programs** are in a continual “state of readiness” for CERCLA five-year reviews.

Savannah River Site, SC

- ✓ Supported 5-year review process including regulatory compliance and review of 22 RODs.

Army Environmental Center, Technology Evaluation at Army Installations


- ✓ Involved in 40+ remedial program reviews.
- ✓ Provided experts in hydrology, risk assessment, and remedial technology deployment.


Loring AFB (LAFB) and Aberdeen Proving Ground (APG)

- ✓ Documentation of system performance and recommendations for improvements resulting from SAIC’s optimization programs used in direct support of the CERCLA 5-year review process.
- ✓ Level of detail and documentation provided by SmartSite™ met or exceeded the requirements of the 5-year review process.

DOE’s Paducah Gaseous Diffusion Plant (PGDP), KY

- ✓ Current CERCLA 5-year review activities involve several highly complex sites.
- ✓ Conducted 5-year reviews for 9 remedial/removal actions conducted under CERCLA.






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Optimization Support of Site Closure


- Evaluate current environmental and regulatory conditions.
- Update risk assessment assumptions.
- Fate and transport and risk modeling (TIE, RBCA, etc.)
- Update and optimize site closure strategy.

Site Name	Program Overview	Strategies Employed	Results
Goss Cove Sub Base, New London	Allegations of impacted impacts	TIE Evaluation of toxicity	NFA
Olivetti Supplies	VOC contaminated soil and groundwater	Sequential closure; RBCA	Site Closure, divesture, and commercial reuse
Bethlehem Works Site	160 acres of soil and groundwater impacts, various substances	Source removal; RBCA, cleanup standards; Alternative exposure scenarios	Site closed, divested, redevelopment as commercial and historical park complex
Bethlehem Steel Plant Site	80 acres filled with arsenic bearing wastes	Site specific RBCA treatment standards	Site closed, divested, and redeveloped as office park
CBS Manufacturing Facility	VOCs and metals in lagoon, soil, and groundwater	Treatability studies, phytoremediation, fate and transport modeling for RBCA treatment	Site closed, divested, and reused as manufacturing site
Witco Bakerstown Drum Site	3600 drums of hazardous waste and contaminated soils	Waste segregation and stabilization, closure under State Act II program	Site closed

SAIC's number one goal is to accelerate to closure



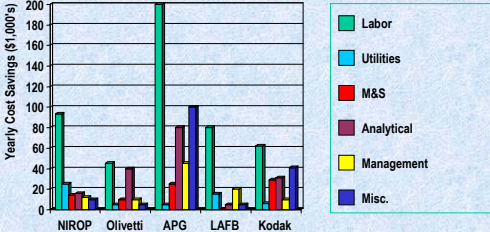
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SmartSite Results in Savings In All Program Areas

- Formal accounting approach** results in fully documented cost analysis
- Programmatic approach** yields savings in all cost categories
- Systems engineering analysis** identifies maximum savings in interrelated areas
- SCADA/Information Technology** - Proven value

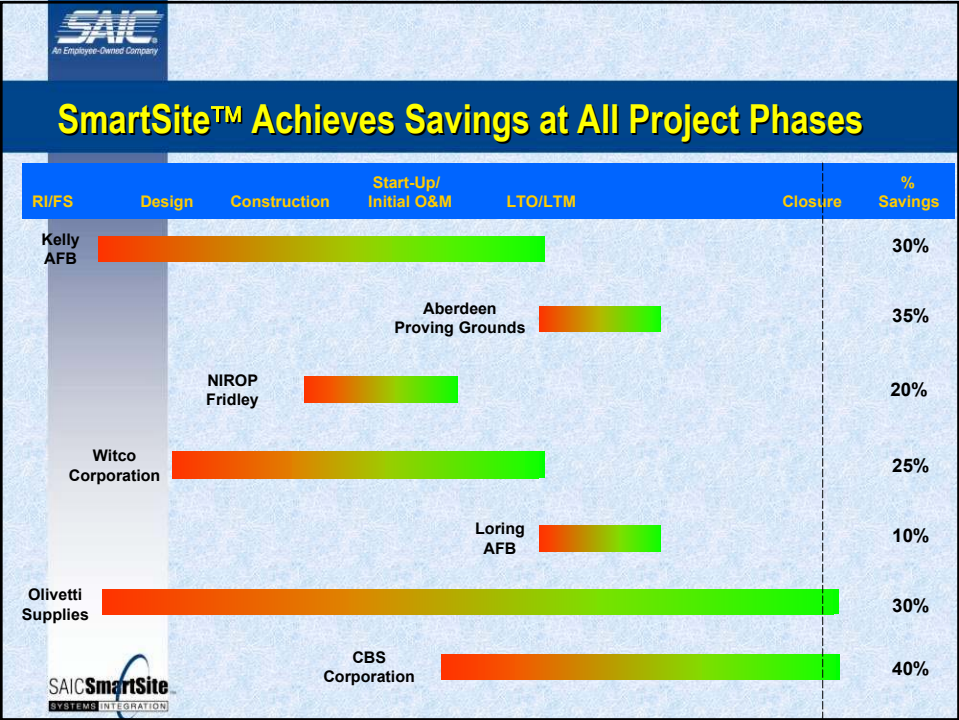


Site	Labor	Utilities	M&S	Analytical	Management	Misc.
NIROP	90	20	10	10	10	10
Olivetti	40	10	10	10	10	10
APG	200	10	10	10	10	10
LAFB	80	10	10	10	10	10
Kodak	60	10	10	10	10	10

Savings well beyond groundwater optimization



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Optimization Projects - Rules of Thumb


- Percent savings and ROI increase greatly with program costs > \$200K/yr for four years or longer.
- Staged approach to optimization controls project costs.
- Optimization is a joint effort.
- High value alternatives have ROI < 2 years.
- Significant savings result from comprehensive reevaluation of assumed program requirements and objectives.
- SCADA and IT tools reduce costs on nearly every program.


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Optimization Projects - Rules of Thumb (cont'd)


- Opportunities for savings identified during the initial site visit generally involve procedures, equipment, and supplies.
- Additional opportunities identified by systems analysis of interrelated activities and costs - often management and procedures.
- Total savings consist of numerous small vs few large savings.
- Buy-in of the current operators is necessary to assure validity and maximize value of optimization project (avoid sandbagging).
- Operators have improvements conceptualized that have not been communicated or evaluated to determine value.






Accessing the Institutional Knowledge Base


- Promote trust through initial explanation of objectives and continued communication and involvement.
- Facilitate operating team's ongoing optimization program.
- Identify and acknowledge existing ideas and continuing contributions to improvements.
- Promote formal and continued involvement in project optimization.
- Give credit and recognition for all results and contributions.
- Be sensitive and use common sense and good people skills.






Summary of Optimization Project Experience


- Potential savings increase with increasing program scope, complexity, and duration.
- Programmatic approach provides logical basis for analysis and accounting of costs and savings.
- Wide variety of many, small, interrelated vs. few, large, independent savings.
- Systems analysis of interrelated problems and solutions captures maximum savings.
- Savings in all program areas at all program phases.






Summary of Optimization Project Experience (cont.)


- Potential savings of 15%-30% per yr., ROI <3 yrs.
- Additional nonmonetary and long term benefits.
- Team effort required and operator buy-in is essential.
- No “cookbooks”/“silver bullets” - Wide range in technology tools and experience required to address wide range in optimization opportunities.
- Changing programs and metrics, and emerging optimization tools promotes continued optimization.
- LTO/LTM = Long-Term Optimization/Long-Term Management.






Summary of Key Points


- Savings increase with increasing program scope, complexity, and duration.
- Program element framework enables analysis and accounting of costs and savings.
- Maximum cost reduction derived from capturing many, small, interrelated vs. few, large, independent savings.
- Systems analysis of interrelated problems and solutions captures maximum savings.
- Savings available in all program areas and phases.






Summary of Key Points (cont.)


- Optimization improves management and remedial system effectiveness and accelerates site closure.
- Potential savings of 20%-40% per yr., ROI <3 yrs.
- Additional benefits include compliance, safety, reliability, and public relations.
- Team effort required and operator buy-in is essential.
- Wide range in technology tools and experience required to address wide range in optimization opportunities.
 - “Cookbooks” are ineffective and largely ignored.
 - “Silver bullet” = “snake oil” if applied inappropriately.






Summary of Key Points (cont.)

- Information technologies enable more effective interactive site management.
- Optimization starts as an event and becomes an ongoing daily program.
- Changing programs and metrics, and ongoing technology development promotes continued optimization.
- LTO/LTM = Long-Term Optimization/Long-Term Management.





Summary

- RAO/LTM Optimization Requirements Are Highly Variable and Technology and Site-Specific
- Systematic and Comprehensive Approach Fully Documents Baseline Conditions
- Multidisciplinary Team Provides Quality Evaluation
- Wide Range in Opportunities for Cost-Saving
- A Systems Analyses of Interdependent Problems and Solutions Yields Optimum Cost Savings
- A Systems Engineering Approach Maximizes Total, Long-Term Cost Savings
- Savings Generally Exceed 20%

